ENVIRONMENTAL MONITORING PROGRAM INFORMATION

Introduction

The high-level radioactive waste (HLW) presently stored at the Western New York Nuclear Service Center (WNYNSC) on the West Valley Demonstration Project (WVDP) premises is the byproduct of spent nuclear fuel reprocessed during the late 1960s and early 1970s by Nuclear Fuel Services, Inc.(NFS).

Inasmuch as the WNYNSC is no longer an active nuclear fuel reprocessing facility, the environmental monitoring program focuses on measuring radioactivity and chemicals associated with the residual effects of NFS operations and the Project's high-level waste treatment and low-level waste management operations. The following information about the operations at the WVDP and about radiation and radioactivity will be useful in understanding the activities of the Project and the terms used in reporting the results of environmental testing measurements.

Radiation and Radioactivity. Radioactivity is a process in which unstable atomic nuclei spontaneously disintegrate or "decay" into atomic nuclei of another isotope or element. (See *isotope*, p.5, in the Glossary.) The nuclei decay until only a stable, nonradioactive isotope remains. Depending on the isotope, this process can take anywhere from less than a second to hundreds of thousands of years.

As atomic nuclei decay, radiation is released in three main forms: alpha particles, beta particles, and gamma rays. By emitting energy or particles, the nucleus moves toward a less energetic, more stable state.

Alpha Particles. An alpha particle, released by decay, is a fragment of a much larger nucleus. It consists of two protons and two neutrons (similar to a helium atom nucleus) and is positively charged. Compared to beta particles, alpha particles are relatively large and heavy and do not travel very far when ejected by a decaying nucleus. Alpha radiation, therefore, is easily stopped by a thin layer of material such as paper or skin. However, if radioactive material is ingested or inhaled, the alpha particles released inside the body can damage soft internal tissues because all of their energy is absorbed by tissue cells in the immediate vicinity of the decay. An example of an alpha-emitting radionuclide is the uranium isotope with an atomic weight of 232 (uranium-232). Uranium-232 is in the high-level waste mixture at the WVDP as a result of a thorium-based nuclear fuel reprocessing campaign conducted by NFS and has been previously detected on occasion in liquid waste streams.

Beta Particles. A beta particle is an electron that results from the breakdown of a neutron in a radioactive nucleus. Beta particles are small compared to alpha particles, travel at a higher speed (close to the speed of light), and can be stopped by a material such as wood or aluminum less than an inch thick. If beta particles are released inside the body they do much less damage than an equal number of alpha particles. Because they are smaller and faster and have less of a charge, beta particles deposit energy in fewer tissue cells and over a larger volume than alpha particles. Strontium-90, a fission product (see Glossary, p.4), is an example of a beta-emitting radionuclide. Strontium-90 is found in the stabilized supernatant.

Gamma Rays. Gamma rays are high-energy "packets" of electromagnetic radiation, called photons, that are emitted from the nucleus. They are similar to x-rays but generally have a shorter wavelength and therefore are more energetic than x-rays. If the alpha or beta particle released by the decaying nucleus does not carry off all the energy generated by the nuclear disintegration, the excess energy may be emitted as gamma rays. If the released energy is high, a very penetrating gamma ray is produced that can be effectively reduced only by shielding consisting of several inches of a heavy element, such as lead, or of water or concrete several feet thick. Although large amounts of gamma radiation are dangerous, gamma rays are also used in many lifesaving medical procedures. An example of a gamma-emitting radionuclide is barium-137m, a short-lived daughter product of cesium-137. Both barium-137m and cesium-137 are major constituents of the WVDP high-level radioactive waste.

Measurement of Radioactivity. The rate at which radiation is emitted from a disintegrating nucleus can be described by the number of decay events or nuclear transformations that occur in a radioactive material over a fixed period of time. This process of emitting energy, or radioactivity, is measured in curies (Ci) or becquerels (Bq).

The curie is based on the decay rate of the radionuclide radium-226 (Ra-226). One gram of radium-226 decays at the rate of 37 billion nuclear disintegrations per second (3.7E+10 d/s), so one curie equals 37 billion nuclear disintegrations per second. One becquerel equals one decay, or disintegration, per second. (See the Scientific Notation section at the back of this report for information on exponentiation, i.e., the use of "E" to mean the power of 10.)

Very small amounts of radioactivity are sometimes measured in picocuries. A picocurie is one-trillionth (1E-12) of a curie, equal to 3.7E-02 disintegrations per second, or 2.22 disintegrations per minute.

Measurement of Dose. The amount of energy absorbed by the receiving material is measured in rads (radiation absorbed dose). A rad is 100 ergs of radiation energy absorbed per gram of material. (An erg is the approximate amount of energy necessary to lift a mosquito one-sixteenth of an inch.) "Dose" is a means of expressing the amount of energy absorbed, taking into account the effects of different kinds of radiation.

Alpha, beta, and gamma radiation affect the body to different degrees. Each type of radiation is given a quality factor that indicates the extent of human cell damage it can cause compared with equal amounts of other ionizing radiation energy. Alpha particles cause twenty times as much damage to internal tissues as x-rays, so alpha radiation has a quality factor of 20 compared to gamma rays, x-rays, or beta particles, which have a quality factor of 1.

The unit of dose measurement to humans is the rem (roentgen-equivalent-man). Rems are

Ionizing Radiation

Radiation can be damaging if, in colliding with other matter, the alpha or beta particles or gamma rays knock electrons loose from the absorber atoms. This process is called ionization, and the radiation that produces it is referred to as ionizing radiation because it changes an electrically neutral atom, in which the positively charged protons and the negatively charged electrons balance each other, into a charged atom called an ion. An ion can be either positively or negatively charged. Various kinds of ionizing radiation produce different degrees of damage.

Potential Effects of Radiation

The biological effects of radiation can be either somatic or genetic. Somatic effects are restricted to the person who has been exposed to radiation. For example, sufficiently high exposure to radiation can cause clouding of the lens of the eye or loss of white blood cells.

Radiation also can cause chromosomes to break or rearrange themselves or to join incorrectly with other chromosomes. These changes may produce genetic effects and may show up in future generations. Radiation-produced genetic defects and mutations in the offspring of an exposed parent, while not positively identified in humans, have been observed in some animal studies.

The effect of radiation depends on the amount absorbed within a given exposure time. The only observable effect of an instantaneous whole-body dose of 50 rem (0.5 Sv) might be a temporary reduction in white blood cell count. An instantaneous dose of 100-200 rem (1-2 Sv) might cause additional temporary effects such as vomiting but usually would have no long-lasting side effects.

Assessing biological damage from low-level radiation is difficult because other factors can cause the same symptoms as radiation exposure. Moreover, the body apparently is able to repair damage caused by low-level radiation.

The effect most often associated with exposure to relatively high levels of radiation appears to be an increased risk of cancer. However, scientists have not been able to demonstrate with certainty that exposure to low-level radiation causes an increase in injurious biological effects, nor have they been able to determine if there is a level of radiation exposure below which there are no biological effects.

Background Radiation

Background radiation is always present, and everyone is constantly exposed to low levels of such radiation from both naturally occurring and manmade sources. In the United States the average total annual exposure to this low-level background radiation is estimated to be about 360 millirem (mrem) or 3.6 millisieverts (mSv). Most of this radiation, approximately 295 mrem (2.95 mSv), comes from natural sources. The rest comes from medical procedures, consumer products, and other manmade sources. *(See p.4-3 in Chapter 4, Radiological Dose Assessment.)*

Background radiation includes cosmic rays, the decay of natural elements such as potassium, uranium, thorium, and radon, and radiation from sources such as chemical fertilizers, smoke detectors, and televisions. Actual doses vary depending on such factors as geographic location, building ventilation, and personal health and habits.

equal to the number of rads multiplied by the quality factor for each type of radiation. Dose can also be expressed in sieverts. One sievert equals 100 rem.

Environmental Monitoring Program Overview

Human beings may be exposed to radioactivity primarily through air, water, and food. At the WVDP all three pathways are monitored, but air and surface water pathways are the two primary means by which radioactive material can move off-site.

The geology of the site (types of soil and bedrock), the hydrology (location and flow of surface water and groundwater), and meteorological characteristics of the site (wind speed, patterns, and direction) are all considered in evaluating potential exposure through the major pathways.

The on-site and off-site monitoring program at the WVDP includes measuring the concentration of alpha and beta radioactivity, conventionally referred to as "gross alpha" and "gross beta," in air and water effluents. Measuring the total alpha and beta radioactivity from key locations, which can be done within a matter of hours, produces a comprehensive picture of on-site and off-site levels of radioactivity from all sources. In a facility such as the WVDP, frequent updating and tracking of the overall levels of radioactivity in effluents is an important tool in maintaining acceptable operations.

More detailed measurements are also made for specific radionuclides. Strontium-90 and cesium-137 are measured because they have been previously detected in WVDP waste materials. Radiation from other important radionuclides such as tritium or iodine-129 are not sufficiently energetic to be detected by gross measurement techniques, so these must be analyzed separately using methods with greater sensitivity. Heavy elements such as uranium, plutonium, and americium require special analysis to be measured because they exist in such small concentrations in the WVDP environs.

The radionuclides monitored at the Project are those that might produce relatively higher doses or that are most abundant in air and water effluents. Because manmade sources of radiation at the Project have been decaying for more than twenty years, the monitoring program does not routinely include short-lived radionuclides, i.e., isotopes with a half-life of less than two years, which would have only 1/1,000 of the original radioactivity remaining. (See Appendix B [pp. B-1 through B-44] for the schedule of samples and radionuclides measured and Appendix K, Table K-1 [p.K-3] for related Department of Energy [DOE] protection standards, i.e., derived concentration guides [DCGs] and half-lives of radionuclides measured in WVDP samples.)

Data Reporting. Because the decay of radioactive atoms is a random process, there is an inherent uncertainty associated with all environmental radioactivity measurements. This can be demonstrated by repeatedly measuring the number of atoms that decay in a radioactive sample over some fixed period of time. The result of such an experiment would be a range of values for which the average value would provide the best indication of how many radioactive atoms were present in the sample.

However, in actual practice a sample of the environment usually is measured for radioactivity just once, not many times. The inherent uncertainty of the measurement, then, stems from the fact that it cannot be known whether the result that was obtained from one measurement is higher or lower than the "true" value, i.e., the average value that would be obtained if many measurements had been taken.

The term confidence interval is used to describe the range of measurement values above and below the test result within which the "true"

Derived Concentration Guides

A derived concentration guide (DCG) is defined by the DOE as the concentration of a radionuclide in air or water that, under conditions of continuous exposure by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation) for one year, would result in an effective dose equivalent of 100 mrem (1 mSv) to a "reference man." These concentrations — DCGs — are considered screening levels that enable site personnel to review effluent and environmental data and to decide if further investigation is needed. (See Table K-1, Appendix K, p.K-3 for a list of DCGs.)

DOE Orders require that the hypothetical dose to the public from facility effluents be estimated using specific computer codes. (See Dose Assessment Methodology [p.4-5] in Chapter 4, Radiological Dose Assessment.) Doses estimated for WVDP activities are calculated using actual site data and are not related directly to DCG values.

Dose estimates are based on a sum of isotope quantities released and the dose equivalent effects for that isotope. For liquid effluent screening purposes, percentages of the DCGs for all radionuclides present are added. If the total percentage of the DCGs is less than 100, then the effluent released complies with the DOE guideline.

Although the DOE provides DCGs for airborne radionuclides, the more stringent U.S. Environmental Protection Agency (EPA) National Emission Standards for Hazardous Air Pollutants (NESHAP) apply to Project airborne effluents. As a convenient reference point, both air and water sampling results are compared with DCGs throughout this report.

value is expected to lie. This interval is derived mathematically. The width of the interval is based primarily on a predetermined confidence level, i.e., the probability that the confidence interval actually encompasses the "true" value. The WVDP environmental monitoring program uses a 95% confidence level for all radioactivity measurements and calculates confidence intervals accordingly.

The confidence interval around a measured value is indicated by the plus-or-minus ($\pm$) value following the result, e.g., 5.30 $\pm$ 3.6E-09 μCi/mL, with the exponent of 10^{-9} expressed as "E-09." Expressed in decimal form, the number would be 0.00000000530 $\pm$ 0.0000000036 μCi/mL. A sample measurement expressed this way is correctly interpreted to mean "there is a 95% probability that the concentration of radioactivity in this sample is between 1.7E-09μCi/mL and 8.9E-09μCi/mL."

If the confidence interval for the measured value includes zero (e.g., 5.30 $\pm$ 6.5E-09μCi/mL), the value is considered to be below the detection limit. The values listed in tables of radioactivity measurements in the appendices include the confidence interval regardless of the detection limit value.

In general, the detection limit is the minimum amount of constituent or material of interest detected by an instrument or method that can be distinguished from background and instrument noise. Thus, the detection limit is the lowest value at which a sample result shows a statistically positive difference from a sample in which no constituent is present.

Nonradiological data conventionally are presented without an associated uncertainty and are expressed by the detection limit prefaced by a "less-than" symbol (<) if that analyte was not measurable. (See also Data Assessment and Reporting [p.5-7] in Chapter 5, Quality Assurance.)

Changes in the 1999 Environmental Monitoring Program. Changes in the 1999 environmental monitoring program enhanced the environmental sampling and surveillance network in order to support current activities and to prepare for future activities.

- Stack monitoring equipment upgrades for the supernatant treatment system/permanent ventilation system (STS/PVS) were completed in September 1999. The point of sample withdrawal (ANSTSTK) remained the same in the PVS stack, and equipment for real-time, continuous monitoring of stack effluents was relocated from the PVS building to a dedicated shelter nearby.

- To accommodate replacement of the lag storage area (LSA)-4 waste storage structure and construction of the new shipping depot, the on-site ambient air monitoring location for diffuse source emissions from the lag storage areas was co-located with stack monitoring equipment for the container sorting and packaging facility (ANCSPFK).

Appendix B summarizes the program changes (p.B-iv) and lists the sample points and parameters measured in 1999 (pp.B-1 through B-44).

Vitrification Overview. High-level radioactive waste from NFS operations was originally stored in two of four underground tanks (tanks 8D-2 and 8D-4). The waste in 8D-2, the larger of the active tanks, had settled into two layers: a liquid — the supernatant — and a precipitate layer on the tank bottom — the sludge. To solidify the high-level waste, WVDP engineers designed and developed a process of pretreatment and vitrification.

Pretreatment Accomplishments. The supernatant (in tank 8D-2) was composed mostly of sodium and potassium salts dissolved in water. Radioactive cesium in solution accounted for more than 99% of the total radioactivity in the supernatant. During pretreatment, sodium salts and sulfates were separated from the radioactive constituents in both the liquid portion of the high-level waste and the sludge layer in the bottom of the tank.

Pretreatment of the supernatant began in 1988. The integrated radwaste treatment system (IRTS) reduced the volume of the high-level waste needing vitrification by producing low-level waste stabilized in cement: The supernatant was passed through zeolite-filled ion exchange columns in the supernatant treatment system (STS) to remove more than 99.9% of the radioactive cesium. The resulting liquid was then concentrated by evaporation in the liquid waste treatment system (LWTS). This low-level radioactive concentrate was blended with cement in the cement solidification system (CSS) and placed in 269-liter (71-gal) steel drums. The cement-stabilized waste form has been accepted by the U.S. Nuclear Regulatory Commission (NRC).

In the last step the steel drums were stored in an on-site aboveground vault, the drum cell. Processing of the supernatant was completed in 1990, with more than 10,000 drums of cemented waste produced.

The sludge that remained was composed mostly of iron hydroxide. Strontium-90 accounted for most of the radioactivity in the sludge. Pretreatment of the sludge layer in high-level waste tank 8D-2 began in 1991. Five specially designed 50-foot-long pumps were installed in the tank to mix the sludge layer with water in order to produce a uniform sludge blend and to dissolve the sodium salts and sulfates that would interfere with vitrification. After mixing and allowing the sludge to settle, processing of the wash water through the integrated radwaste treatment system began. Processing removed radioactive constituents for later solidification into glass, and the wash water containing salt was then stabilized in cement.

Sludge washing was completed in 1994 after approximately 765,000 gallons of wash water had been processed. About 8,000 drums of cement-stabilized wash water were produced.

In January 1995, high-level waste liquid stored in tank 8D-4 was transferred to tank 8D-2. (Tank 8D-4 contained THOREX high-level radioactive waste, which had been produced by a single reprocessing campaign of a special fuel containing thorium that had been conducted from November 1968 to January 1969 by the previous facility operators.) The resulting mixture was washed and the wash water was processed. The IRTS processing of the combined wash waters was completed in May 1995.

In all, through the supernatant treatment process and the sludge wash process, more than 1.7 million gallons of liquid had been processed by the end of 1995, producing a total of 19,877 drums of cemented low-level waste.

As one of the final steps, the ion-exchange material (zeolite) used in the integrated radwaste treatment system to remove radioactivity was blended with the washed sludge before being transferred to the vitrification facility for blending with the glass-formers. In 1995 and early 1996 final waste transfers to high-level waste tank 8D-2 were completed in preparation for vitrification.

Preparation for Vitrification. Nonradioactive testing of a full-scale vitrification system was conducted from 1984 to 1989. In 1990 all vitrification test equipment was removed to allow installation of shield walls for fully remote radioactive operations. The walls and shielded tunnel connecting the vitrification facility to the former reprocessing plant were completed in 1991.

The slurry-fed ceramic melter was fully assembled, bricked, and installed in 1993, and the cold chemical building was completed, as was the sludge mobilization system that transfers high-level waste to the melter. This system was fully tested in 1994. Several additional major systems components also were installed in 1994: the canister turntable, which positions the stainless steel canisters as they are filled with molten glass; the submerged bed scrubber, which cleans gases produced by the vitrification process; and the transfer cart, which moves filled canisters to the storage area.

Nonradiological testing ("cold" operations) of the vitrification facility began in 1995, and the first canister of nonradiological glass was produced. The WVDP declared its readiness to proceed with the necessary equipment tie-ins of the ventilation and utility systems to the vitrification facility building and tie-ins of the transfer lines to and from the high-level waste tank farm and the vitrification facility. In this closed-loop system, the transfer lines connect to multiple common lines so that material can be moved among all the points in the system. High-level waste vitrification began in 1996 and continued throughout 1999.

1999 Activities at the WVDP

The WVDP's environmental management system is an important factor in the environmental monitoring program and the accomplishment of its mission. Significant components, initiatives, and pertinent information about the work accomplished at the WVDP in 1999 are summarized below.

Vitrification. Solidification of the high-level waste in glass continued in 1999. The high-level waste mixture of washed sludge and spent zeolite from the ion-exchange process is combined in batches with glass-forming chemicals and then fed to a ceramic melter. The waste mixture is heated to approximately 2,000°F and poured into stainless steel canisters. Approximately 270 stainless steel canisters eventually will be needed to hold all of the vitrified waste.

Each canister, 10 feet long by 2 feet in diameter, is filled with a uniform, high-level waste glass that will be suitable for eventual shipment to a federal repository. During Phase I (June 1996 to June 1998) 210 canisters were filled.

In 1999 more than 0.6 million curies of radioactivity were transferred to the vitrification facility and fifteen high-level waste canisters were produced. Since the beginning of vitrification in 1996 through calendar year 1999, 245 high-level waste canisters have been filled and more than 11 million cesium/strontium curies have been transferred to the vitrification facility and vitrified.

Environmental Management of Aqueous Radioactive Waste. Water containing radioactive material from site process operations is collected and treated in the low-level waste treatment facility LLW2. (Water from the sanitary system, which does not contain added radioactive material, is managed in a separate system.)

The treated process water is held, sampled, and analyzed before it is released through a State Pollutant Discharge Elimination System (SPDES)-permitted outfall. In 1999, 29.1 million liters (7.67 million gal) of water were treated in the LLWTF system (i.e., the LLW2 and associated lagoons) and discharged through outfall 001, the lagoon 3 weir. The discharge waters contained an estimated 12.3 millicuries of gross alpha plus gross beta radioactivity. Comparable releases during the previous fourteen years averaged about 39 millicuries per year. The 1999 release was about 32% of this average. (See Radiological Monitoring: Surface Water, Low-level Waste Treatment Facility Sampling Location [p.2-2] in Chapter 2.)

Approximately 0.11 curies of tritium were released in WVDP liquid effluents in 1999 — 7% of the fourteen-year average of 1.47 curies.

Environmental Management of Airborne Radioactive Emissions. Ventilated air from the various points in the IRTS process (high-level waste sludge treatment, main plant and liquid waste treatment system, and the cement solidification system) and from other waste management activities is sampled continuously during operation for both particulate matter and for gaseous radioactivity. In addition to monitors that alarm if particulate matter radioactivity increases above pre-set levels, the sample media are analyzed in the laboratory for the specific radionuclides that are present in the radioactive materials being handled.

Air used to ventilate the facilities where radioactive material cleanup processes are operated is passed through filtration devices before being emitted to the atmosphere. These filtration devices are generally more effective for particulate matter than for gaseous radioactivity. For this reason, facility air emissions tend to contain a greater amount of gaseous radioactivity (e.g., tritium and iodine-129) than radioactivity associated with particulate matter (e.g., strontium-90 and cesium-137). However, gaseous radionuclide emissions still remain so far below the most restrictive regulatory limit for public safety that additional treatment technologies beyond that already provided by, for example, the vitrification off-gas treatment system, are not necessary.

Gaseous radioactivity emissions from the main plant in 1999 included approximately 6.77 millicuries of tritium (as hydrogen tritium oxide [HTO]) and 1.90 millicuries of iodine-129. (See Chapter 2, p.2-24, for a discussion of iodine-129 emissions from the main plant stack.) As expected, these 1999 values are quite low when compared to 1997, a year in which the vitrification system was in operation for the entire year at a relatively high rate of production and tritium and iodine-129 emissions were 140 millicuries and 7.43 millicuries respectively.

Particulate matter radioactivity emissions from the main plant in 1999 included approximately 0.2 millicuries of beta-emitting radioactivity and 0.001 millicuries of alpha-emitting radioactivity. In 1997, beta-emitting and alpha-emitting radioactivity emissions were 0.4 millicuries and 0.001 millicuries respectively.

Environmental Management of Radiological Exposure. Radiological exposures measured at on-site monitoring locations DNTLD24, located near the chemical process cell waste storage area (CPC-WSA), and DNTLD36, located near the drum cell, have shown steady decreases for several years. (See Fig.A-10 [p.A-12] for the locations of these two monitoring points.) Exposure data for these two monitoring locations are shown in Figures 1-1 (*below*) and 1-2 (*p.1-10*).

The beginning of the long-term steady decrease in exposure at DNTLD24 correlates well with the cessation of placement of waste containers in the CPC-WSA in 1987 and with the decay of the mix of isotopes in the stored waste. The decreases noted at DNTLD36 can be attributed to the cessation of the placement of waste drums in the drum cell as well as the decay of the mix of isotopes in the stored waste over time and to the revised stacking plan initiated in 1990, which changed the arrangement of waste and shield drums in the drum cell.

Unplanned Radiological Releases. There were no unplanned air or liquid radiological releases on-site or to the off-site environment from the Project in 1999.

NRC-licensed Disposal Area (NDA) Interceptor Trench and Pretreatment System. Radioactively contaminated n-dodecane in combination with tributyl phosphate (TBP) was discovered at the northern boundary of the NDA in 1983, shortly after the DOE assumed control of the WVDP site. Extensive sampling and monitoring through 1989 revealed the possibility that the n-dodecane/TBP could migrate. To contain this subsurface organic contaminant migration, an interceptor trench and liquid pretreatment system (LPS) were built.

The trench was designed to intercept and collect subsurface water, which could be carrying n-dodecane/TBP, in order to prevent the material from entering the surface water drainage ditch leading into Erdman Brook. The LPS was installed to decant the n-dodecane/TBP from the water and to remove iodine-129 from the collected water before its transfer to the low-level waste treatment facility. The separated n-

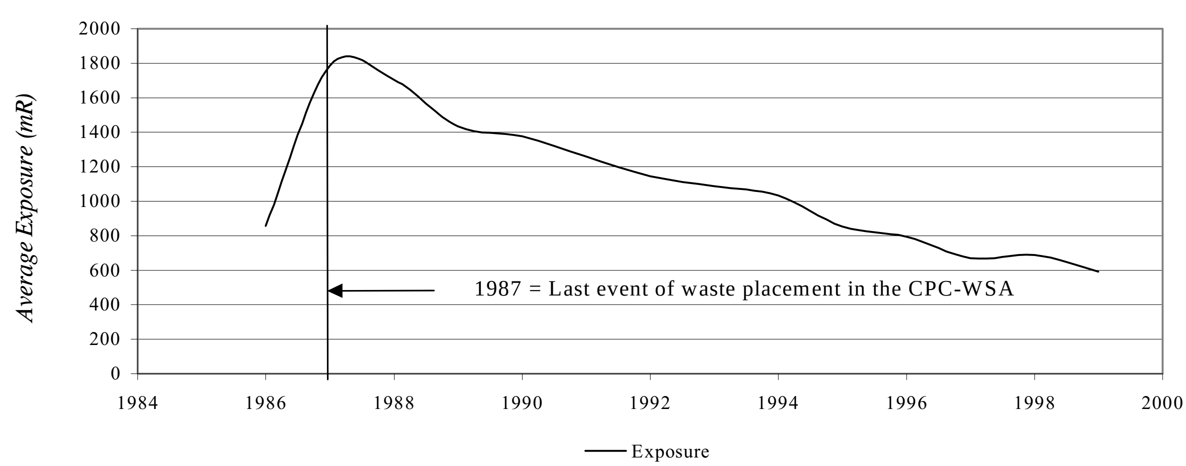

Figure 1-1. Average Annual Exposure at DNTLD24

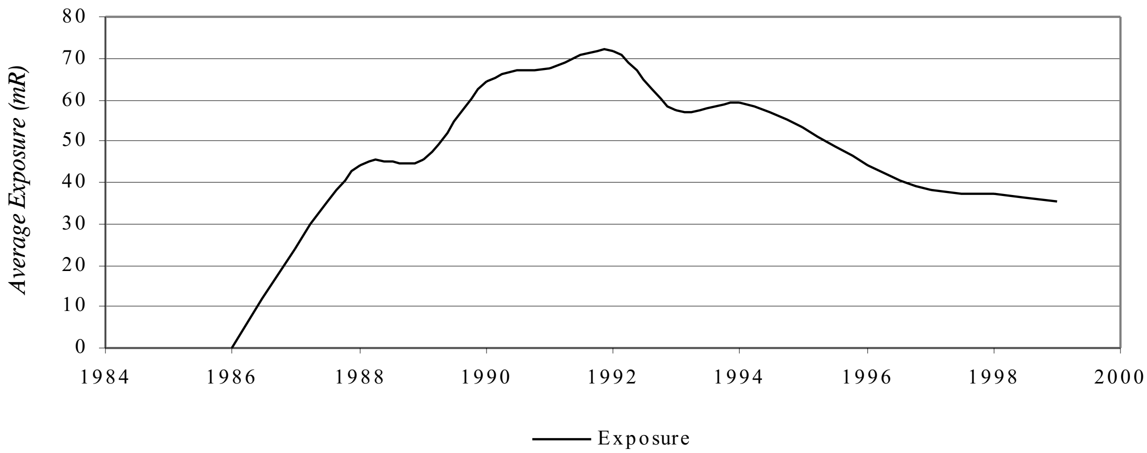

Figure 1-2. Average Annual Exposure at DNTLD36

dodecane/TBP would be stored for subsequent treatment and disposal.

As in previous years, no water containing n-dodecane/TBP was encountered in the trench and no water or n-dodecane/TBP was treated by the LPS in 1999. Approximately 650,000 liters (172,000 gals) of water were collected from the interceptor trench and transferred to lagoon 2 during the year. Results of surface and groundwater monitoring in the vicinity of the trench are discussed in Chapter 2 under SDA and NDA Sampling Locations, p.2-6, and in Chapter 3 under Results of Monitoring at the NDA, p.3-13.

Waste Minimization Program. The WVDP formalized a waste minimization program in 1991 to reduce the generation of low-level waste, mixed waste, and hazardous waste. This program is a comprehensive and continual effort to prevent or minimize pollution, with the overall goal of reducing health and safety risks, protecting the environment, and complying with all federal and state regulations. (For more details see the Environmental Compliance Summary: Calendar Year 1999 Waste Minimization and Pollution Prevention [p.ECS-5].)

Pollution Prevention Awareness Program. The WVDP's pollution prevention (P2) awareness program is a significant part of the Project's waste minimization program. The goal of the program is to make all employees aware of the importance of pollution prevention both at work and at home.

A crucial component of the P2 awareness program at the WVDP is the Pollution Prevention Coordinators group. This group communicates, shares, and publicizes prevention, reduction, reuse, and recycling information to all departments at the WVDP. The P2 coordinators identify and facilitate the implementation of effective source reduction, reuse, recycling, and procurement of recycled products. Six self-directed teams evaluate specific concerns and issues and make recommendations for resolution.

Waste Management. In 1998 the Waste Management department implemented the Waste Management Reengineering Action Plan, a program to improve methods of addressing waste management at the WVDP.

To define the path forward for disposal of all WVDP radioactive wastes, a waste management strategic policy, Planning for Waste Disposal, was developed and issued in November 1999. The policy provides an overall methodology for ensuring that wastes are fully recognized and evaluated and that methods for effectively managing waste for dispositioning are included in work plans.

Radman®, a characterization and shipping software system, was used to profile the miscellaneous debris waste stream. The Project's low-level waste miscellaneous debris profile was approved by Envirocare, and the WVDP initiated shipments in February 1999 under the DOE Ohio Field Office (DOE-OH) consolidated contract.

To ensure up-front characterization of all radiological wastes, waste management personnel were assigned to assist on-site groups with large projects that would generate waste (e.g., removal of laboratory wastes from the process mechanical cell and removal of wastes from the scrap removal room tank).

WVNS improved cost effectiveness and enhanced operational efficiency while maintaining sound conduct-of-operations principles by following through on the goals set in the Waste Management Reengineering Action Plan and the Planning for Waste Disposal policy. Specific accomplishments include:

- shipping 35,400 cubic feet of low-level waste during fiscal year 1999, which was more than 40% above the 1999 goal and an increase of more than 600% compared to the amount of low-level waste shipped in any previous year

- reclaiming almost 40,000 cubic feet of indoor storage space through space-saving activities

- removing fabric and structural steel from lag storage area (LSA)- 4 under budget and on time

- dewatering and repacking more than 300 containers of ion-exchange resin from tanks in the 02 building

- completing ahead of schedule a major remediation of areas containing asbestos

- reducing the inventory of clean lead by approximately 39,000 pounds

- demonstrating intermodal container use, including container preparation for loading and transport to Pennsylvania for rail shipment of waste to Envirocare

- improving the low-level waste storage capacity report

- completing Site Treatment Plan milestones on or ahead of schedule.

An Environmental Affairs assessment team, including three specialists from the Westinghouse Savannah River site and Safe Sites of Colorado, visited the site to assess waste management programs and confirmed compliance with RCRA requirements.

DOE-OH/WVDP also audited the environmental management and waste management systems in August 1999 and found that both systems were effective and that personnel have thorough technical expertise and regulatory knowledge.

National Environmental Policy Act Activities. Under the National Environmental Policy Act (NEPA), the Department of Energy is required to consider the overall environmental effects of its proposed actions or federal projects. The President's Council on Environmental Quality established a screening system of analyses and documentation that requires each proposed action to be categorized according to the extent of its potential environmental effect. The levels of documentation include categorical exclusions (CXs), environmental assessments (EAs), and environmental impact statements (EISs).

Categorical exclusions evaluate and document actions that will not have a significant effect on the environment. Environmental assessments evaluate the extent to which the proposed action will affect the environment. If a proposed action has the potential for significant effects, an environmental impact statement is prepared that describes proposed alternatives to an action and explains the effects.

Facility maintenance and minor projects that support high-level waste vitrification are documented and submitted for approval as categorical exclusions, although environmental assessments occasionally are necessary for larger-scale activities.

In December 1988 the DOE published a Notice of Intent to prepare an environmental impact statement for the completion of the WVDP and closure of the facilities at the WNYNSC. The environmental impact statement describes the potential environmental effects associated with Project completion and various site closure alternatives.

The draft environmental impact statement was completed in 1996 and released for a six-month public review and comment period. Having met throughout 1997 and 1998 to review alternatives presented in the environmental impact statement, the Citizen Task Force issued the West Valley Citizen Task Force Final Report (July 29, 1998). This report provided recommendations and advice on the development of a preferred alternative. The Citizen Task Force continues to meet and discuss issues related to Project completion and site closure decision-making.

Because the Nuclear Regulatory Commission (NRC) is authorized by the West Valley Demonstration Project Act to prescribe decommissioning criteria for the WVDP, the NRC staff proposed such criteria for the Project to the NRC Commissioners in 1998 (Decommissioning Criteria for West Valley, October 30, 1998 [SECY 98-251]). The DOE, NYSERDA, the New York State Department of Environmental Conservation (NYSDEC), and the Citizen Task Force were invited to a public meeting on January 12, 1999 to provide input to the NRC on their issues and concerns.

In addition to the public comment process required by the National Environmental Policy Act, NYSERDA, with participation from the DOE, formed a Citizen Task Force in January 1997. The mission of the Task Force is to assist in the development of a preferred alternative for the completion of the West Valley Demonstration Project and the cleanup, closure, or long-term management of the facilities at the Western New York Nuclear Service Center. The Task Force process has helped illuminate the various interests and concerns of the community, increased the two-way flow of information between the site managers and the community, and provided an effective way for the Task Force members to establish a mutually agreed upon set of recommendations for the site managers to consider in their decision-making process.

As a result of this meeting, the NRC issued a Staff Requirements Memorandum (SRM) on January 26, 1999, requesting additional information on the proposed decommissioning criteria. In response, the NRC staff provided SECY 99-057, Supplement to SECY 98-251. The NRC subsequently issued an SRM on June 3, 1999 based on the contents of both SECY 98-251 and SECY 99-057 and the written and oral comments from interested parties. This SRM approved the NRC's License Termination Rule (LTR) as the decommissioning criteria to be applied to the WVDP and the West Valley site.

On December 3, 1999, the NRC published in the Federal Register (Vol.64, No.232, pp. 67952-67954) its draft policy statement and issued a notice of a public meeting to be held on January 5, 2000 at the Ashford Office Complex to solicit public comment on the draft policy statement. The NRC's draft policy statement is available electronically at http://www.nrc.gov/NRC/ADAMS/index.html.

In addition, copies of SECY 98-251, SECY 99-057, a transcript of the January 12, 2000 public meeting, the January 26, 1999 SRM and the June 3, 1999 SRM, and the NRC's vote sheets on SECY 98-251 and SECY 99-057 can be obtained electronically at http://www.nrc.gov/NRC/COMMISSION/activities.html.

Self-assessments. Self-assessments continued to be conducted in 1999 to review the management and effectiveness of the WVDP environmental protection and monitoring programs. Results of these self-assessments are evaluated and corrective actions are tracked through completion. Overall results of these self-assessments found that the WVDP continued to implement and in some cases improve the quality of the environmental protection and monitoring program. (See the Environmental Compliance Summary: Calendar Year 1999 [p.ECS-17] and Chapter 5, Quality Assurance [p.5-6].)

Occupational Safety and Environmental Training. The occupational safety of personnel who are involved in industrial operations under DOE cognizance is protected by standards mandated by DOE Order 5480.4, Environmental Protection, Safety, and Health Protection Standards, which directs compliance with specific Occupational Safety and Health Act (OSHA) requirements. This act governs diverse occupational hazards ranging from electrical safety and protection from fire to the handling of hazardous materials. The purpose of OSHA is to maintain a safe and healthy working environment for employees.

Hazardous Waste Operations and Emergency Response regulations require that employees at treatment, storage, and disposal facilities, who may be exposed to health and safety hazards during hazardous waste operations, receive training appropriate to their job function and responsibilities. The WVDP Environmental, Health, and Safety training matrix identifies the specific training requirements for such employees.

The WVDP provides the standard twenty-four-hour hazardous waste operations and emergency response training. (Emergency response training includes spill response measures and controlling contamination of groundwater.) Training programs also contain information on waste minimization, pollution prevention, and the WVDP environmental management program. Besides this standard training, employees working in radiological areas receive additional training on subjects such as understanding radiation and radiation warning signs, dosimetry, and respiratory protection. In addition, qualification standards for specific job functions at the site are required and maintained. These programs have evolved into a comprehensive curriculum of knowledge and skills necessary to maintain the health and safety of employees and ensure the continued compliance of the WVDP.

The WVDP maintains a hazardous materials response team that is trained to respond to spills of hazardous materials. This team maintains its proficiency through classroom instruction and scheduled training drills.

Medical emergencies on-site are handled by the WVDP Emergency Medical Response Team. This team consists of on-site professional medical staff, volunteer New York State-certified emergency medical technicians, and main plant operators who are certified as New York State First Responders.

Any person working at the WVDP who has a picture badge receives general employee training covering health and safety, emergency response, and environmental compliance issues. All visitors to the WVDP receive a site-specific briefing on safety and emergency procedures before being admitted to the site.

Voluntary Protection Program STAR Status. The WVDP was recommended for the Voluntary Protection Program (VPP) STAR Status in 1999 in recognition of outstanding safety achievements. For additional information on the VPP see the Environmental Compliance Summary: Calendar Year 1999, p. ECS-16.

ISMS Implementation. A plan to integrate environmental, safety, and health (ES&H) management programs at the WVDP was developed and initiated at the WVDP during 1998. During development of the ISMS, the enhanced work planning program (EWP) was identified as an integral part of the ISMS and a site-wide work review group was established to review work plans, identify ES&H concerns, and specify practices that ensure that work is performed safely.

Implementation of an ISMS at the WVDP, including the EWP, was verified by the DOE Ohio Field Office in November 1998. In September 1999 a self-assessment verified that the ISMS continues to be carried out according to the system description. As a result of the self-assessment, the environmental management system (EMS) was revised to describe its relationship to the ISMS. No additional actions were required by the self-assessment.

EMS Implementation. The WVNS environmental management system provides the basic policy and direction of work at the WVDP through procedures that support proactive management, environmental stewardship, and the integration of appropriate technologies throughout all aspects of the work at the WVDP.

The Project's environmental management system satisfies the requirements of the Code of Environmental Management Principles (CEMP) for federal agencies and ISO 14001, Environmental Management Systems: Specification for Guidance and Use, which is being implemented worldwide. The CEMP was developed by the EPA in response to Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements, in order to serve as the basis for responsible environmental management. Following the principles and performance objectives of the CEMP helps to ensure that a federal facility's environmental performance is proactive, flexible, cost-effective, and sustainable.

Performance Measures

Performance measures can be used to evaluate effectiveness, efficiency, quality, timeliness, productivity, safety, or other areas that reflect achievements related to organization or process goals and can be used as a tool to identify the need to institute changes.

The performance measures applicable to operations conducted at the WVDP, discussed here, reflect process performance related to wastewater treatment in the low-level waste treatment facility, the identification of spills and releases, the reduction in the generation of wastes, the potential radiological dose received by the maximally exposed off-site individual, and the transfer of high-level waste to the vitrification system.

Radiation Doses to the Maximally Exposed Off-Site Individual. One of the most important pieces of information derived from environmental monitoring program data is the potential radiological dose to an off-site individual from on-site activities. As an overall assessment of Project activities and the effectiveness of the as-low-as-reasonably achievable (ALARA) concept, the effective radiological dose to the maximally exposed off-site individual is an indicator of well-managed radiological operations. The effective dose equivalents for air effluent emissions, liquid effluent discharges, and other liquid releases (such as swamp drainage) from 1993 through 1999 are graphed in Figure 1-3 (*below*). Note that the sum of these values is well below the DOE standard of 100 mrem. These consistently low results indicate that radiological activities at the site are well-controlled. (See also Table 4-2 [p.4-7] in Chapter 4, Radiological Dose Assessment.)

SPDES Permit Limit Exceptions. Effective operation of the site wastewater treatment facilities is indicated by compliance with the applicable discharge permit limitations. Approximately sixty parameters are monitored regularly as part of the SPDES permit requirements. The analytical results are reported to NYSDEC via Discharge Monitoring Reports required under the SPDES program.

Although the goal of the low-level waste treatment facility (LLWTF) and wastewater treatment facility (WWTF) operations is to maintain effluent water quality consistently within the permit requirements, occasionally SPDES permit limit exceptions do occur. All SPDES permit limit exceptions are evaluated to determine their cause and to identify corrective measures. A Water Task Team composed of WVDP personnel with expertise in wastewater engineering, treatment plant operations and process monitoring, and NPDES/SPDES permitting and compliance was formed in 1995 to address the causes of these exceptions.

Since 1995 virtually all of the recorded exceptions had been for parameters such as nitrite, pH, and five-day biochemical oxygen demand (BOD_5), which regulate or are greatly influenced by natural (microbiological) treatment processes occurring at the site's industrial and sanitary WWTF and the LLWTF. The Water Task Team's efforts produced significant results: for the second consecutive year there were no permit limit exceptions. (See Fig.1-4 [p.1-16].)

Although exceptions are not always related to operating deficiencies, corrective actions may

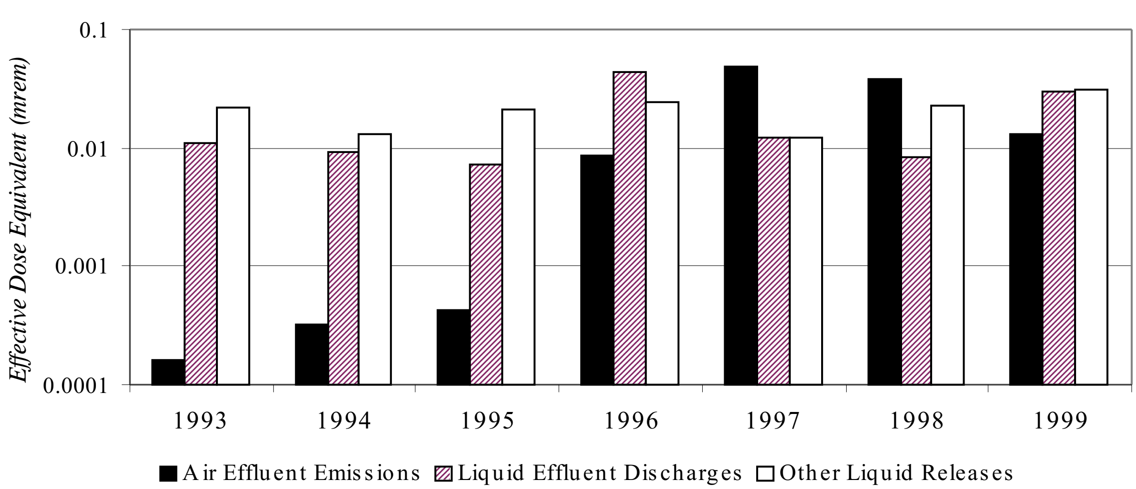

Figure 1-3. Annual Effective Dose Equivalent to the Maximally Exposed Off-site Individual

include improved operation or treatment techniques. In 1997 the WVDP notified NYSDEC of the presence of mercury in the influent wastewater to the LLWTF and of its likely presence at outfall 001 at concentrations below the detectable level of 0.2 μg/L. In 1998 and 1999 an increase in the mercury concentration was observed in process wastewater from the liquid waste treatment system (LWTS) evaporator, water that is eventually treated at the LLWTF. The LWTS evaporator processes radioactive wastewater from the high-level radioactive waste vitrification and supernatant treatment operations.

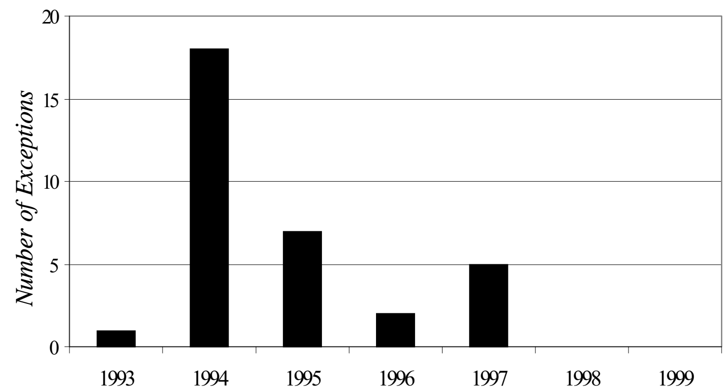

Figure 1-4. Yearly SPDES Permit Exceptions

Tests were performed on the radioactive wastewater from the evaporator to determine the performance of various treatment media in removing the mercury. A professional engineer's report on construction and operation of a treatment system to remove mercury from the evaporator wastewater was prepared and submitted to NYSDEC in December 1999 for approval.

During 1999 a system was implemented that will evaluate the potential effects on LLWTF effluents from the dispositioning of waste streams with variable contaminant concentrations. Initial evaluation of several small-volume hazardous, mixed, and industrial waste streams suggested that these wastes were suitable for disposal at the interceptors, the head-works of the LLWTF, without affecting compliance with discharge limits.

Disposition of these waste streams requires review and evaluation of SPDES-regulated constituent loadings to determine whether the proposed discharge is within the SPDES permit limits and to provide assurances that the resulting discharge will not constitute release of RCRA-regulated mixed wastes to the lagoon system. The WVDP developed a computerized spreadsheet that automatically calculates and estimates concentrations of RCRA- and SPDES-regulated constituents in the mixture of all wastewater streams entering the interceptors. The calculations are based on conservative (worst case) assumptions and on the known regulated constituent concentrations and volumes in routinely generated wastewater streams and in the nonroutine waste streams proposed for discharge.

After several weeks of trial use the automated calculation procedure was implemented through WVDP standard operating procedures. Since its initial development, the computerized spreadsheet calculations have been used to evaluate more than thirty separate nonroutine wastewater streams for disposition to the LLWTF during 1999.

Waste Minimization and Pollution Prevention. The WVDP has initiated a program to reduce the quantities of waste generated from site activities. Reductions in the generation of low-level radioactive waste, radioactive mixed waste, hazardous waste, industrial wastes, and sanitary wastes such as paper, glass, plastic, wood, and scrap metal were targeted. To demonstrate the effectiveness of the waste minimization program, a graph of the percentage of waste reduction achieved above the annual goal for each category is presented in Figure 1-5 (*below*) for calendar years 1993 through 1999.

Not all waste streams have been tracked over this period. Note that the low-level radioactive waste figures from 1993 through 1995 include the volume of drummed waste produced in the cement solidification system. The hazardous waste quantity for 1994 also includes about 1,900 kilograms (4,200 lbs) of waste produced in preparing for vitrification. Hazardous waste and industrial waste volumes have been tracked separately for vitrification-related and nonvitrification-related waste streams since vitrification began in 1996. To maintain historical comparability, the percentages in Figure 1-5 include only the nonvitrification portions of these two waste streams.

Specific waste minimization achievements include the following:

- 200 tons of excess clean lead in storage were sold to a recycling vendor
- 141 tons of scrap carbon and stainless steel were recycled
- 93 tons of structural steel and tent fabric (from the demolition of lag storage area #4) were sold to a recycling vendor
- permeable treatment wall (PTW) sheet piles used for a pilot project were saved and stored for reuse in the future rather than being disposed
- soft water was piped to the laundry to reduce the calcium concentration in the water and extend the useful life of ion-exchange resin, which captures calcium and cesium ions, resulting in a 50% reduction in the need for laundry detergent and an associated reduction in the volume of ion-exchange resin
- one-time use anti-contamination articles were replaced with washable items to significantly reduce the use of plastic bags and tape in radioactive work areas.

Spills and Releases. Chemical spills greater than the applicable reportable quantity must be reported immediately to NYSDEC and the National Response Center and other agencies as required. There were no reportable chemical spills during 1999.

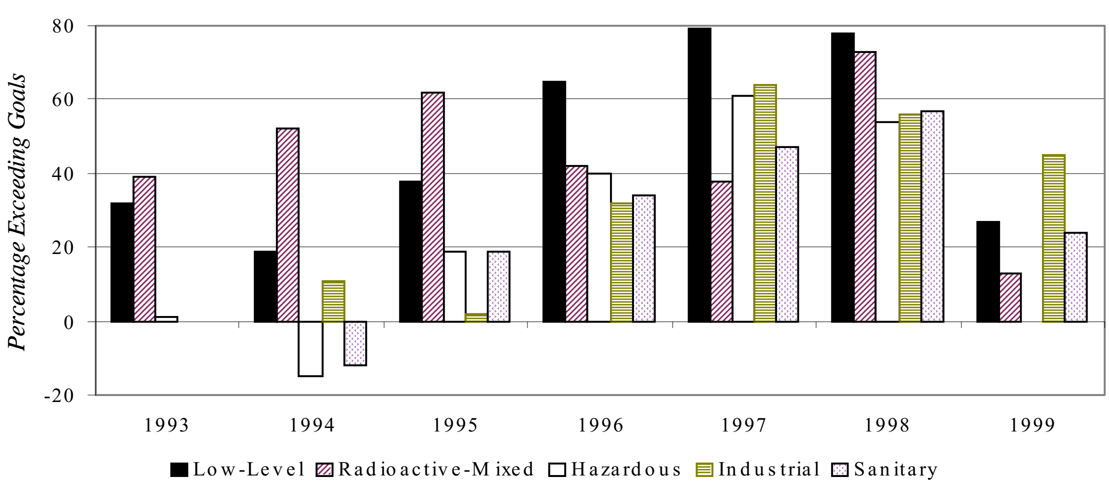

Figure 1-5. Percentage of Waste Reduction Exceeding Annual Goals

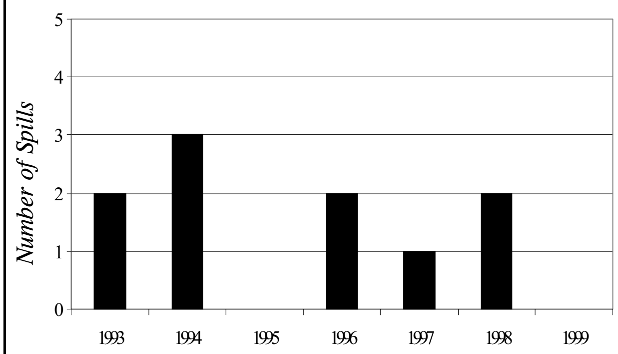

Figure 1-6. Number of Immediately Reportable Spills or Releases

Petroleum spills greater than 5 gallons or of any amount that travel to waters of the state must be reported immediately to the NYSDEC spill hotline and entered in the monthly log. There were no reportable petroleum spills in 1999. Figure 1-6 (*above*) is a bar graph of immediately reportable spills from 1993 to 1999.

Prevention is the best means of protection against oil, chemical, and hazardous substance spills or releases. WVDP employees are trained in applicable standard operating procedures for equipment that they use, and best management practices have been developed that identify potential spill sources and measures that will reduce the potential for releases to occur. Spill training, notification, and reporting policies have also been developed to emphasize the responsibility of each employee to report spills immediately upon discovery. This first-line reporting helps to ensure that spills will be properly documented and mitigated in accordance with applicable regulations.

Vitrification. To safely solidify the high-level radioactive waste at the site in borosilicate glass, the high-level waste sludge is transferred in batches from the tank where it currently is stored to the vitrification facility. After transfer, the waste is solidified into a durable glass for safe storage and future transport to a federal repository. It is estimated that 11 million to 12 million curies of strontium and cesium radioactivity in the high-level waste eventually will be vitrified. (Radioactive cesium and strontium isotopes account for 98% of the long-lived radioactivity.) To quantify the progress made toward completing the vitrification goal, Figure 1-7 (*below*) shows the number of curies transferred to the vitrification facility in 1999.

On June 10, 1998, the WVDP marked completion of the Project's production phase (Phase I) of high-level waste processing. This milestone included safely vitrifying 85% of the high-level waste inventory in 210 canisters of solidified waste glass and immobilizing more than 9.3 million curies of radioactivity. More than 11.0 million curies were immobilized through vitrification and 245 canisters were filled by the end of 1999, bringing the Project total of immobilized liquid high-level waste to more than 20.7 million curies, including pretreatment and vitrification.

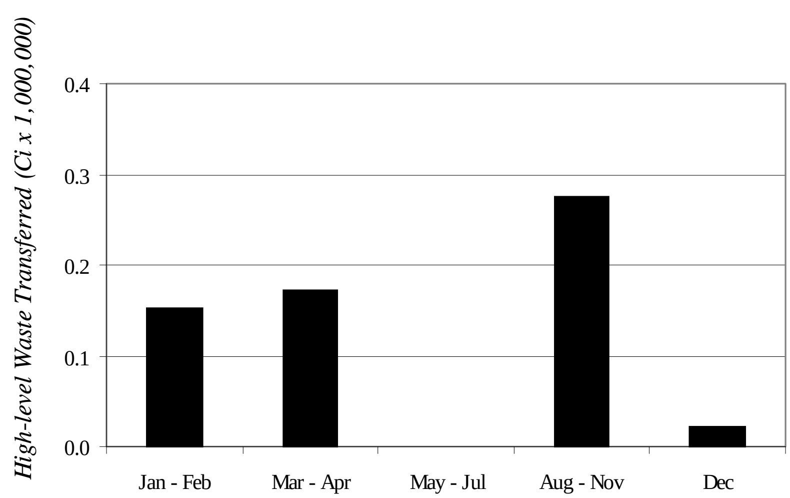

Figure 1-7. Number of Curies Transferred to the Vitrification Facility in 1999